SPECIAL REPORTS

ON

I.—The Fisheries of Canada

II.—On the Treatment and Planting of Salmonoid Fry

III.—The Propagation of Black Bass

BY

PROFESSOR E. E. PRINCE, B.A., F.R.S.
Commissioner of Fisheries for Canada

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I.

THE FISHERIES OF CANADA.

BY PROFESSOR EDWARD E. PRINCE, DOMINION COMMISSIONER OF FISHERIES, OTTAWA.

Last year I had the honour of being invited by the Royal Society of Canada to deliver the annual evening address at their May meeting. It is not customary to put in permanent form a popular address of that nature; but when asked this year to contribute a short article on fisheries to the "Handbook of Canada," prepared for the British Association for the Advancement of Science, which held its sixty-sixth meeting in Toronto, I summarized my notes for the purpose, in the form of a *résumé*.

The present account is based upon the Royal Society address and the *résumé*, referred to. The time appears opportune for publishing this sketch, as there is no work available, which attempts an adequate review of Canada's fishery resources, fishery administration, &c. There are, it is true, accounts by Joncas, Lemoine and others, and works upon provincial fisheries by Perley, Knight and lesser known writers, but the great fisheries of the west have received very inadequate treatment as compared with those of the east, and a summarized sketch of the whole subject is now essayed, it is believed, for the first time.

That the fisheries of Canada are the most vast in extent and the most varied in their products, can hardly be questioned. The Dominion's waters on the Pacific and Atlantic shores teem with fish of the greatest economic value, while the system of fresh water lakes, really inland seas, which stretch in a linear direction for over a thousand miles; the productive lakelets, countless in number, and the noble rivers which flow through her far-reaching territory, provide the amplest field for gigantic fishing industries.

The annual value of the inland and sea fisheries has been variously estimated; but it cannot be much below $30,000,000. Official returns, it is generally admitted, underestimate rather than overestimate their total value, as vast quantities of fish are used for food which it is hardly possible to accurately estimate, and enormous catches are made in remote regions of Canada of which no returns are available. Fishermen generally exhibit an unwillingness to state with any precision the amount and value of their takes each season; and shipments of fish are frequently taken from Canadian fishermen by United States tugs, especially upon the great lakes, which are not entered upon Dominion records.

The growth of the fisheries has been phenomenal. In 1850 their value did not exceed $150,000; in 1852 the value was doubled, and in 1859 it rose to $1,407,000, while ten years later (1869) it amounted to $4,376,526. By 1872 the value again more than doubled, and reached $9,570,116. In 1877 it was $12,005,934; in 1887, $18,386,103, and official estimates this year put it at $20,407,424, which do not probably adequately account for the value of fish consumed by the Indians, the Eskimo, and settlers in remote districts of the Dominion, or the large quantities shipped from Hudson Bay, Hudson Strait and other distant waters.

An army of fishermen, 75,237 in number, possessing boats, nets and gear valued at about $10,000,000 engage in these fisheries. Many profitable industries are largely connected with and dependent upon the fisheries, such as boat building, net and twine manufactures, the making of cans (for salmon, &c.) some of these industries being extensive. The following summary, suggested by the system of territorial regions which Sir William Dawson laid down in his work on the "Ice Age," recognizes seven great divisions, each characterized by fisheries more or less distinctive.

REGIONAL DIVISIONS.

(1.) The Atlantic division, from the Bay of Fundy to the coast of Labrador, embracing deep-sea and inshore fisheries, cod, mackerel, haddock, halibut, herring, hake, lobsters, oyster, seal and white whale (Beluga) fisheries. Annual value: $10,000,000.

(2.) The Estuarine and inland waters of the Maritime Provinces (Nova Scotia, New Brunswick, Prince Edward Island and Quebec), including fisheries for salmon, shad, gaspereaux (alewife), striped bass, smelt, and in the lakes, ouananiche or fresh water salmon, lake trout or lunge, maskinonge, &c., of the annual value of $2,500,000.

(3.) The great lakes and tributary waters: Lake whitefish, great lake trout, lesser whitefish (called erroneously lake herring), sturgeon, pike-perch, (doré or pickerel), black bass, brook-trout, maskinonge, pike and numerous carps, suckers and catfish. Value: $2,000,000.

(4.) Great North-west lakes, including Manitoba and northern waters, yielding lake whitefish, sturgeon, pike-perch, tullibee (a peculiar lesser whitefish), pike and gold-eye (a true fresh-water herring).

Value, including newly developed "caviare" and "sturgeon sounds" industries, $1,000,000.

(5.) Pacific interior, or Rocky Mountain plateau, comprising little developed fisheries, land-locked Pacific salmon, lake whitefish, lake trout, river trout and numerous *cyprinoids*, none of which are propably identical with eastern species. Annual value small and unrecorded.

(6.) Pacific coast fisheries which are almost unworked, if the estuarine salmon fisheries be excepted. At least seven different species of Pacific salmon occur belonging to the genus *Oncorhynchus*, excluding *Salmo gairdneri*, the steelhead. Halibut, skill (black cod), oolachan (candle fish), anchovy, herring, smelt, and a great variety of other marketable fishes abound, but are not to any adequate extent utilized. Shark, dog-fish and whale fisheries exist, and there are limited oyster fisheries. Exclusive of the fur seal, which is an oceanic industry, less than $1,000,000 in value, the coast fisheries may be given at $4,000.000.

(7.) Hudson's Bay and Peri-Arctic area (Ungava Bay to the Mackenzie River), Whale, walrus, sea-trout, the inconnu, resembling a huge river whitefish, pike, suckers, sturgeon, and possibly salmon and cod, occur in these vast waters, of which Hudson Bay alone exceeds the Mediterranean Sea in extent. The richest whaling grounds in the world are in this little-known part of Canada, off the mouth of Mackenzie River and as far east as Cape Chudleigh, in Hudson Strait, where the Baleen whale and walrus were until recently numerous. "The tidal channels of Canada's Arctic archipelago are destined," it has been truly said "to be the last home of the leviathans, which within the memory of living men, have been driven from Newfoundland latitudes to the places where their survivors have now sought retreat."

COAST LINE, LAKE AREAS, &C.

It may be pointed out that the waters grouped in this seven-fold manner include on the Atlantic, a Canadian coast line at least 10,000 miles long, and on the Pacific not less than 8,000 miles, while the portions of the great lakes (Superior, Huron, Erie and Ontario), which lie within the British boundary line, embrace a fishing area computed at 72,700 square miles, and containing one-half the fresh water upon the surface of the globe. To these extensive waters must be added giant streams like the St. Lawrence, the largest river on the North American continent, having a drainage area of 367,000 square miles, the Mackenzie River (over 2,000 miles long), the Saskatchewan (2,000 miles long), the Fraser and Red Rivers, each 600 miles long, and others, like the rivers Peace, Nelson, Albany, Great Whale, Skeena, Ottawa, St. John, Restigouche and Miramichi, all of which are great rivers abounding in the choicest species of fish.

There are few rivers or lakes in this vast continental stretch, which do not furnish to the angler fishing with rod and line unapproachable elsewhere. The

salmon rivers of the maritime provinces have no equal, and the inland waters inhabited in the east mainly by speckled trout; and further west, especially in Ontario, by black bass and maskinongé, afford the highest kind of sport. The large trout of the Nepigon River and Lake Nepigon in western Ontario have a reputation hardly inferior to the ouananiche or fresh-water salmon of Lake St. John, in the province of Quebec.

The principal salmon streams of New Brunswick and Quebec, such as the famous Restigouche, the peerless Miramichi, the St. John and its tributaries, the Nipissiquit, the Cascapedia, the Saguenay, &c., are for the most part leased by clubs or private parties, many of them from the United States, and their commodious club-houses occur at picturesque points along the banks. Such is the value placed upon angling in some of these waters that the Cascapedia, which may be cited as an example, was leased not long ago by the Quebec Provincial Government at no less a sum than $6,125 per annum. While angling for trout and other fish, excepting salmon, has in the past been freely permitted in the various provinces, the necessity with the increase of sportsmen and the leasing of lakes and rivers has arisen for effective restrictions. In Ontario, for example, no one except resident Canadians can angle for bass, maskinonge, trout, &c., without a permit which is issued at a moderate fee. The Commissioner of Crown Lands, Toronto, has power to issue free permits for one month for waters adjacent to Crown lands, and visitors who are domiciled for a time in Canada may have the privilege of fishing without permit or license. In waters so numerous and extensive as those of Canada the angler has no difficulty in finding scope for his *penchant*, and such resorts as the Thousand Islands attract myriads of sportsmen every season. In each province indeed there are localities which abound in game fish where the angler can freely exercise his skill.

In the tidal portions of rivers licenses and leases are granted by the Department of Marine and Fisheries for commercial fishing, and in the estuary of such rivers as the Restigouche and Miramichi, most extensive salmon netting for the market is carried on. In the harbour of St. John the net fishings are under the control of the city of St. John, but elsewhere the Dominion Government possesses the leasing or licensing power. As already stated, the provincial governments have the right to issue leases for non-tidal portions in the case of ungranted frontages; but this power is vested in the riparian proprietors in the case of granted lands. In Nova Scotia and Ontario the waters, as a rule, are not leased, and the riparian owner's rights have not been very generally enforced.

It is important to note that the Atlantic inshore fisheries of Canada, embracing an area of more than 15,000 square miles, are prosecuted not by Canadian fishermen alone, but by those of the United States, Newfoundland and France under international treaties. The great lakes also are, for the most part, divided between the United States and Canada, and the recorded Canadian catches represent therefore only a proportion of the total yield of those waters.

In Hudson Bay and the northern seas, as well as in the Pacific inshore waters of British Columbia, foreign fishermen have very largely encroached on the fishery resources of the Dominion. There are, it may be added, extensive waters as yet untried and undeveloped, and valuable resources which in the near future will add to the annual value of the Canadian fisheries.

The importance of the fishing industries did not in the past go unrecognized. A government department charged with the administration of fishery, as well as shipping matters, was created at Confederation (1867), prior to which the fisheries had been regulated by a branch organized in 1859, of the Crown Lands Department of Upper Canada. Such control as the provincial governments still exercise in Ontario, Quebec, and the other provinces, is carried out by the Commissioners of Crown Lands in the several provinces. Since Confederation the vast fisheries of the Dominion have been under the direct supervision of a Cabinet Minister (the Minister of Marine and Fisheries) at Ottawa. A Deputy Minister acts immediately under the Minister, and has the administration of the department in his hands, while a Commissioner of Fisheries, who is also General Inspector for the Dominion, has important

advisory and executive functions. In addition to the usual inside staff of officers and clerks, there is a body of outside officers who enforce at a yearly cost of about $120,000, the close seasons, and the fishery license system, collect statistics, &c.

The staff includes 12 inspectors of fisheries (who receive $700 to $1,500 per annum): several hundred overseers, vested with magisterial powers for the purposes of the Fisheries Act, (receiving $100 to $900): and a still larger body of temporary fishery guardians, whose pay ranges from $1.50 to $2 per day. A fleet of armed cruisers, costing about $100,000 annually, patrol the coastal and great inland waters, exercising surveillance over foreign as well as Canadian fishing operations in Dominion waters. Finally, a bounty system is carried out for encouraging the pursuit of the deep-sea fisheries in the Atlantic, the provision for which was secured by the Halifax Award, (November 23, 1877), whereby a sum of $5,500,000 was paid by the United States in consideration of the fishery concessions in Canadian inshore waters along the Atlantic coast granted to the United States fishermen. A sum of $160,000, voted annually by Parliament is by this means available, and is distributed amongst the deep-sea fishermen in the Maritime Provinces. The work of the Fisheries Department is thus extremely varied and important. The late Professor Brown Goode, United States Commissioner of Fisheries, at a fisheries conference in London, 1883, said:—"It seemed to him that the Canadian Department of Marine and Fisheries was one of the most valuable organizations in the world, and that the system of gathering statistics was one which other countries ought to study with a great deal of care. In the United States they had nothing of the kind." The collection and publication of statistics is indeed an invaluable branch of the department's work.

The methods of protection and restoration adopted by the Department of Marine and Fisheries are:—

(1) Close seasons preventing the capture of spawning fish.
(2) Fishing licenses specifying the kind of net, amount, mesh, &c.
(3) Prohibition of obstructions, pollutions, &c.
(4) Protection of spawning grounds, spawn, immature fish, &c.
(5) Artificial fish culture, as a means of supplementing natural reproduction and introducing fish into new waters.

The last is carried on by means of 14 hatcheries under the supervision of the Commissioner of Fisheries. Salmon (Atlantic and Pacific), great lake trout, and lake whitefish, are hatched and shipped *gratis*, if the waters applied for are suitable. A lobster hatchery at Pictou, N.S., turns out annually one hundred to one hundred and sixty millions of minute larval lobsters. The fish culture operations cost between $30,000 to $40,000 per annum, and in 1895, close upon three hundred millions of fry of the various fishes above named were planted in the several provinces.

A most effective aid to the protection of fish is the prohibition of obstructions caused either by dams or by nets and other fishing apparatus. Main channels of rivers may not be obstructed, and the law requires that nets or fishing apparatus shall leave two thirds of the course of any river or stream clear for the ascent of fish. It is required that fish-passes shall be provided by mill owners or others to enable fish to ascend above dams or barriers and such fish-ways must be kept in efficient condition. In special cases the department is empowered to provide one-half of the cost if the Minister of Marine and Fisheries judges it to be called for. A special provision of the Fisheries Act requires that fish shall not be impeded in their migrations on Sunday, and all nets, fish traps, &c., must therefore be taken out of water, or raised or opened to allow of free passage. In British Columbia for 36 hours each week fishing is prohibited in order to allow of the ascent regularly of a certain proportion of every week's run of salmon.

A sea-fisheries Intelligence Bureau established in 1889, including between fifty and sixty stations under the charge of the Commander of the Protection Fleet, announces daily to the fishermen the movements of fish and the localities for bait.

The following table shows in graduated series the various fish and fish products with the relative value of each for the years 1895 and 1896.

Number.	Kinds of Fish.		1895.		1896.	
			Quantity.	Value.	Quantity.	Value.
				$		$
1	Cod, dried	Cwt.	806,415	3,630,279	809,608	3,610,935
2	do tongues and sounds	Brls.	824	8,240	845	8,450
3	Salmon, preserved, in cans	Lbs.	28,858,897	2,886,479	29,872,740	2,988,258
4	do fresh	"	4,872,770	794,964	5,439,942	965,029
5	do pickled	Brls.	3,825	42,312	3,186	36,498
6	do smoked	Lbs.	56,460	8,962	49,133	11,894
7	Herring, salted	Brls.	511,470	2,301,616	490,171	2,183,559
8	do fresh	Lbs.	11,556,085	295,705	22,289,796	504,893
9	do smoked	"	10,051,613	203,235	10,980,430	221,292
10	Mackerel, salted	Brls.	35,554	497,756	37,765	528,710
11	do fresh	Lbs.	2,068,236	238,899	2,427,972	199,033
12	Lobster, preserved in cans	"	12,345,592	1,666,388	10,906,638	1,526,928
13	do alive or fresh	Tons.	7,374	543,708	8,988	678,834
14	Hake, dried	Cwt.	73,424	186,800	94,808	241,08.
15	do sounds	Lbs.	47,931	23,966	69,867	34,933
16	Haddock, dried	Cwt.	120,758	422,653	125,122	421,204
17	do smoked (finan haddies)	Lbs.	231,000	22,050	1,116,000	72,180
18	Pollock, dried	Cwt.	59,507	148,767	88,781	221,118
19	Trout	Lbs.	6,926,116	692,189	6,950,986	690,699
20	do	Brls.	1,040	10,400	2,275	22,750
21	Whitefish	Lbs.	14,249,399	767,307	13,374,000	773,345
22	Smelts	"	9,022,157	451,108	9,970,805	498,539
23	Halibut	"	3,977,350	270,901	3,672,625	253,435
24	Shad	Brls.	9,639	98,181	8,586	87,370
25	Eels	Lbs.	909,270	54,556	1,037,535	62,252
26	do	Brls.	9,984	96,880	7,333	70,690
27	Alewives	"	48,108	192,432	52,616	209,194
28	Sardines	"	188,089	377,202	86,981	176,414
29	do preserved	Cans.	924,000	46,200	576,700	28,835
30	Bass	Lbs.	1,159,870	85,567	1,294,595	94,442
31	Pickerel	"	7,678,411	303,296	6,897,810	274,931
32	Pike	"	3,592,975	103,325	3,594,790	99,008
33	Maskinonge	"	455,535	27,332	807,950	48,477
34	Sturgeon	"	1,749,520	155,176	2,403,801	152,757
35	Squid	Brls.	15,055	60,220	24,500	98,000
36	Flounders	Lbs.	252,432	12,622	189,159	9,613
37	Winninish	"	100,000	6,000	90,000	5,400
38	Oysters	Brls.	47,673	192,292	48,574	194,296
39	Clams	"	20,022	69,027	19,791	70,960
40	Perch	Lbs.	1,010,580	20,729	1,333,550	38,840
41	Tom-cod or frost fish	"	2,910,510	138,525	2,657,465	137,832
42	Oulachons	"	594,200	30,625	581,500	29,550
43	Coarse and mixed fish	Brls.	80,850	296,789	104,832	284,639
44	Home consumption not included above	Lbs.	1,938,230	269,282	1,894,856	287,896
45	Fur seal skins (British Columbia)	No.	71,359	713,590	55,677	501,093
46	Hair do	"	16,469	18,753	16,808	19,157
47	Sea otter skins	"	16	2,000	23	4,025
48	Beluga (white whale) skins	"	205	820	222	5,328
49	Fish oils	Galls.	620,613	248,246	557,140	224,633
50	do used as bait	Brls.	234,696	352,047	256,146	384,219
51	do do manure	"	105,209	52,605	127,658	63,836
52	do guano	Tons.	3,615	51,155	3,416	49,540
	Total			20,199,338		20,407,424
	Total increase					208,086

METHODS OF FISHING.

At least a dozen methods of taking fish for the markets merit, on account of their importance, a passing notice. The two chief methods are the pound-nets or fish-traps, and the gill-nets or drift-nets. The latter (gill-nets) hang like a wall in the water, with weights, suspended by lines and buoys or floats, and the fish, in their endeavours to pass through, become meshed by the head and strangled. The former (pound-nets or weirs) consists of a "leader" which obstructs the fish and leads them into a staked inclosure, out of which on account of the arrangement of partitions they do not readily escape. Pounds of wickerwork or brush are used in New Brunswick and Nova Scotia for taking sardines, herring and mackerel. Swing nets and other forms of stake-nets are used for salmon, &c., and instead of impounding they gill the fish, but the hoop-nets (or verveux) are perhaps the most widely used for taking the inferior kinds of fish, catfish, suckers (cyprinoids), perch and the like. The hoop-net has the form of a funnel held open by a series of erect wooden hoops and set in creeks and inshore waters. A special form of trap or weir is used for taking eels.

The seine is a most effective net, but on account of its destructive nature, its use has been discouraged. To the extensive use of seines in former years may be attributed the serious decline in some localities of once prolific fisheries. Scoop-nets and bag-nets are used for taking smelts, striped bass and shad. They are successfully used through the ice, in winter, taking immense quantities of fish, carried in with the tide, as the smelt, or when lying torpid like the striped bass, in the winter months.

SALMON AND LOBSTER CANNING.

The vast salmon and lobster canning industries of Canada (salmon on the Pacific coast, and lobsters on the Atlantic coast) are in some respects the most remarkable fishery enterprises in the world. Probably nine to ten millions of salmon are annually used in British Columbia, while every year from eighty to one hundred millions of lobsters are packed in the six or seven hundred lobster factories on the coast of New Brunswick, Prince Edward Island, Quebec and Nova Scotia.

OYSTER FISHERIES.

Finally, the oyster, which differs from the European species in being dicœcious and in its hundred-fold more prolific character, is distributed over vast areas along the Atlantic coast, constituting these areas most extensive and valuable oyster grounds. The annual yield, 50,000 to 70,000 barrels, represents but a tithe of the possible yield, were systematic culture and judicious fishing methods adopted. The Department of Marine and Fisheries has for six years carried on operations, with the aid of a qualified expert, in order to restore and render more prolific certain important oyster beds.

NOTES ON SOME MARKETABLE AND GAME FISH.

It is necessary to add a few succint notes upon certain species of fish of prime importance, commercially, or for sport, which are either peculiar to the waters of this continent or closely allied to European species. The cod, haddock, halibut, mackerel, herring, salmon, pike-perch or doré (also called pickerel), the pike, smelt, eel, and other kinds, call for no special reference, but others like the whitefish, striped bass, &c., demand a brief notice.

Whitefish. *Coregonus clupeiformis* (Mitchill). This fresh water salmonoid is allied to the European Gwyniad and Pollan. It varies in weight from 2 pounds to 16 pounds, and is deep in the body, the shoulder abruptly descending to the head which is very small, the jaws are toothless, the snout blunt, and the gape contracted. The large silvery scales upon its sides, or as some think, the whiteness of the flesh have gained for it its distinctive name. No fish is more justly esteemed for table purposes,

and to explorers and Indians it is invaluable because a continuous diet of whitefish, unlike salmon, never palls upon the taste. There are several species which abound in almost all the lakes from the Atlantic to the Pacific, and their capture constitutes one of the most valuable of the fresh-water fisheries, the annual yield being not less than 9,000 or 10,000 tons, or about one-fifth of the yearly take of cod-fish. The lesser whitefish, called cisco and lake herring, have become valuable in recent years, as the larger species have been considerably depleted. They feed upon insects and small crustaceans, and like the salmonidæ generally, they resort in the fall to their accustomed spawning grounds, traversing, in many cases, great distances to do so.

The speckled trout or brook trout of Canada (*Salvelinus fontinalis*, Mitchill), is more allied to the charrs than to the common river trout (*Salmo fario*, L.), of Europe. Instead of the silvery sides with comparatively large scales, showing minute red and black spots, the Canadian speckled trout has small scales, dusky green back and dorsal fin vividly diversified with yellow vermiform markings, the sides being spotted with red, white and black. The reddish paired fins show a cream-white anterior margin. It is more important for sport than commercially, but its game qualities are inferior to those of the English trout.

The maskinonge (*Esox nobilior*, Le Sueur) bears a general resemblance to the pike (*Esox lucius*, L.), but is in many respects superior. Its edible and game qualities are remarkable, and it often attains a weight of 70 pounds. Whereas the pike is blotched with white on its greenish brown or dusky sides, the maskinonge exhibits brown blotches on a pale ground colour. The branchiostegal rays are 17 to 19 in number, but in the pike 14 to 16. Most of the still waters of Quebec and Ontario contain this fine game fish, but it has greatly decreased in numbers, though splendid fishing is still to be had in lakes Scugog, Rice, Simcoe, and other Ontario waters.

Black Bass (*Micropterus*, Lacep): The two species of black bass rank high in the estimation of the angler. They range from 2 lbs. to 8 lbs., and are bold, strong and gamey. The flesh is firm, white, and of great excellence. The nest-building habits and strong parental instincts of these fish are well known. Striped bass (*Roccus lineatus*, Bloch) occur in the tidal waters along the Atlantic cost. They reach a great size (15 lbs. to 40 lbs.) and afford splendid sport. They are, with the exception of the salmon, the choicest of food fishes, but their destruction when dormant in the rivers in winter, and the taking of the immature young in smelt nets, has seriously depleted them.

Catfishes or Siluroids (*Ameiurus*). A great variety of species occur in the rivers and lakes, and all are characterized by the long feelers which project from the upper and lower jaws. In size they range from 2 or 3 inches, to 4 or 5 feet, and as there is a good demand for them in the United States markets, considerable catfish fisheries have grown up in some localities.

The two Ganoids *Lepidosteus*, (gar-pike) and *Amia*, (Bow-fin or Lake Dog-fish), are fairly plentiful in the lakes and slow streams, especially in Ontario. These fish are interesting as representing the extinct armoured fishes which were abundant in the Devonian and Carboniferous ages. The fossil species were numerous; and their living representatives few. Of the two groups of Ganoïds the osseous and the cartilaginous the sturgeon belongs to the latter, and is now of great market value. Most of the sturgeons descend to to the sea, but one of them (*Acipenser rubicundus*, Le Sueur) is strictly a fresh water form and ranges from 40 lbs. to 120 lbs. in weight while the giant B. C. sturgeon ranges from 500 to 1,200 lbs weight.

Of the shad and the remarkable salmonoids of the Pacific waters, it is not necessary to add any remarks in this necessarily brief sketch.

Ever since the discovery of this vast western continent the richness and value of the Canadian fisheries have been acknowledged, and though the fishing fleets of Norway, Portugal, Spain, France and England, have for centuries prosecuted commercial fishing in the waters of the Dominion, and the old colonial provinces, the United States and the British provinces have taken from them incalculable quantities of fish food for the markets of the old and new world, they still remain the greatest and most varied fisheries in existence.

II.

ON THE TREATMENT AND PLANTING OF SALMONOID FRY.

By Professor E. E. Prince, Dominion Commissioner of Fisheries, Ottawa.

In the report of this department for 1895, I published some notes on the culture of trout. My remarks had reference mainly to the procuring of eggs, the process of fertilization, and the management of the ova during incubation. These notes appear to have aroused widespread interest, and in consequence of their publication a large number of attempts have been made by private parties to commence fish-culture, especially the culture of speckled trout or brook trout. From the number of communications which have reached the Department of Marine and Fisheries upon the hatching and rearing of trout, the hope which I ventured to express has been fully realized when I said "there is evidence of a growing desire in various provinces on the part of enthusiastic individuals to pursue private fish-culture, and to second and to support the efforts of the Department of Marine and Fisheries in recuperating various waters in the Dominion."

It is true that in some concluding paragraphs in the report alluded to, I pointed out some of the conditions necessary, not only for the successful incubation of the eggs of the trout, but also for the rearing of the newly hatched fry. I added some details, indeed, respecting the building of ponds, and the steps desirable to guard against enemies of hurtful influences, in short, I pointed out the precautions required in order to ensure the best results.

The four main considerations for success in planting fry are:

(1) The best age at which fry could be planted in order to ensure the largest results.

(2) The season and climatic conditions best for transport.

(3) The places to be selected for planting.

(4) The precautions necessary to be observed when the fry are in transit.

When the hatching of eggs is carried on upon an extensive scale it is very necessary to commence the work of distribution with as little delay as possible. The advent of warm weather brings many dangers which are avoided by planting in the early and colder days.

Newly hatched fish carry on their under side a large bag of food-yolk upon which they feed by a process of absorption. There is danger in handling fry when the sac is large as the delicate envelope or skin outside is very tender, easily abrades and ruptures, causing the death of the fish. It is wise therefore to allow them to remain in the hatching troughs for 10 or 20 days, by which time the yolk-ball has much diminished and the fish are more hardy and robust. There is of course danger from various causes of losing a large proportion of the fry of whitefish, salmon, and trout if they are retained long after the absorption of the yolk-sac. Fungus, which may also attack eggs during incubation, is one of the most pernicious. What is called "dropsy" in the yolk-sac is not common, inflammation or clogging of the gills is frequent, but fungus is an epidemic that often carries off entire batches of eggs and fry.

The commonest remedy is common salt, of which a saturated solution is made, practically strong brine, and this is poured into the tanks containing the infected fish. It is a good plan to turn off the supply tap so as to leave 2 or 3 inches of water in the tank, and it is easy then to convert the contained water into a fluid not quite the strength of sea-water. It must be thoroughly mixed and the fry left in for about half an hour. Usually the bath has no ill effect; but if the fry appear to be becoming weak or discomforted, the fresh water should be turned on again. A bath of this kind has been found beneficial, though it requires care, as young salmon

immersed in sea-water too long die from hardening of the yolk-sac, which becomes dense like india-rubber. Recently another remedy has been advocated, viz., permanganate of potash, which sweetens the water and destroys organic germs. The *Revue Scientifique* notes that at the Geneva Exhibition, 1896, permanganate of potash was used to clean the aquarium, and it is claimed that it prevented the specimens of the salmonidæ from being attacked by *Saprolegnia*. It is a matter, however, of experiment as yet, and further trials are necessary to establish its success.

One recent experimenter tried a new method and with a small painter's brush or the thumb and finger, removed the fungus, and then with a solution of 18 grs. of bichloride of mercury diluted in a 6 oz. bottle, he applied with a camel-hair brush this solution over the parts affected, holding the fish a few seconds before returning them to the water, which was changed daily. The result, he states, is that after one application his fish entirely recovered, with but a few exceptions, which however, were cured by a second application.

There has been much controversy respecting the merits of planting small and helpless fry and planting yearlings or fingerlings, which have been kept in ponds and fed on artificial food. It is admitted that great loss results when fry are thus impounded, and the trouble and expense are serious if a great quantity of fry are being reared. Some of the best pisciculturists (like Mr. F. Francis) have advocated turning the fish out at once *i. e.*, just before or at the time they begin to feed. The strongest argument in favour of this course, apart from the loss by death and the saving of time, money and labour, is that derived from the contention that fry if kept in artificial inclosures and fed become semi-domesticated after a few months and, when liberated amongst their wild companions already in their streams and lakes, fall victims either to starvation (from inexperience in foraging for food), or to predaceous enemies (from which they have been from the hatching stage carefully guarded). Very young salmon and trout attack their weaker brethren and artificially reared "yearlings" certainly do not commence free life on equal terms, with those reared by nature. There is much therefore to be said in favour of using all haste in planting these fry in suitable places after hatching and before the yolk is entirely absorbed. "They do not want any food" said Frank Buckland "for they are supported by the contents of the umbilical vesicle and at this time above all others require protection. You may at this time increase the flow of water, for I have discovered from painful experience, that water which is sufficient for a given number of eggs is not sufficient for the same number of young fish, when they come out of the eggs." It is, however, a fact that young fry frequently take food, and swallow small particles before the yolk sac has been entirely absorbed. As a rule the yolk has gone before the 35th or 40th day after hatching. If the yolk sac is half-absorbed, say on the 20th day, the fry may be safely planted. They have sufficient food to last them until they are thoroughly accustomed to their natural surroundings, and are able to shift for themselves.

The cool and favourable weather of April, May or early June, unless the season be later than usual, is adapted for distribution, and the risks of loss at that time from long or tedious journeys is reduc d. Such long and perilous trips are as far as possible to be avoided; but they are often necessary in order to reach the shallow upper waters which are most suitable for planting the young fry.

The question has often been discussed whether fry whose incubation has been protracted are stronger than those which have been hatched earlier under a higher temperature. Certainly the mortality in broods of English trout hatched in water below 40° F. is far less than when the water is of a higher temperature. The same has been found to be true of the Canadian speckled trout and the Rainbow trout.

In a series of ova which had reached an advanced stage in water of 48° F., and were then placed in trays supplied with water 10° lower, the hatching out did not take place until the 120th day, though they are known to hatch in 50 or 60 days under a higher temperature. The resulting fry are more robust, and fewer die during the early stages after liberation from the egg than in those hatched at a tem-

perature of 48° to 60°. Actual tests on spawning beds have shown that for long periods the water may not rise above 34° or 35° until April, and the period of hatching is therefore prolonged to 150 or 160 days, with the result that the fry are stronger and more healthy.

In accordance with the conditions which obtain in nature, the fry, after exclusion from the egg, should not be subjected to very low temperatures, but water ranging from 45° to 55° is most suitable. The carrying of fry to the localities where they are to be deposited is an important matter. Railway journeys, if not too protracted, do little harm to fry, unless the cans or tanks holding them are kept too near a stove or hot coils. Excessive heat often proves fatal in railway cars, but as a rule, journeys by rail are less perilous than by team over rough roads, when the shocks and collisions seriously disarrange the delicate organization of the young fry, and damage it is believed the sensitive otocysts of the little fish. Team-drives over rough trails through forests are not conducive to the well-being of fry, and when possible, cans should be carried, in the matter described later, over very rocky or uneven tracts. Conveyance by boat or canoe is by far the best mode. Cans specially contrived for the purpose are best, and should be made of heavy galvanized iron* or stout iron well tinned, and holding 10 to 12 gallons of water. They may be 24 or 26 inches high, and say 18 inches in diameter, but may be of the form of a truncated cone, with a narrow neck in the centre for the purpose of preventing the splashing and loss of water as far as possible. Into the neck (say 6 inches in diameter), a cylindrical can fits, the bottom of which is made of fine metal gauze. The gauze not only allows of æration, but when necessary serves as a receptacle for pieces of ice, which, melting, trickles into the water below in which the fish are swimming about. The ice is often broken up into fine pieces or crushed, if it does not melt and cool the water properly. It should always be remembered that the young of fishes, above all salmonoid fishes, cannot endure heat, nor are they able to withstand frost with impunity. Indeed, ice placed in the lid of the can or tank has proved harmful when on warm days the fry have been surrounded for some hours by water of 50° or 60°. Hence the advisability of transporting young fish either in the early spring months or during the night, and at early morning when the season is warmer and more advanced. At such times they can be most safely shipped.

It is well known that newly hatched fish are far less hardy than eggs. But even eggs during the first few weeks are very sensitive, and within three weeks after fertilization they should be subjected as little as possible to concussions and rough usage. Salmon eggs 22 days old died in 8 or 9 days after being roughly handled during some experiments by the late Dr. Francis Day, the well known British salmon authority, but after the 47th day only very hurtful causes, such as chemical impurities, &c., will do them any harm, and "eyed" eggs are hardy in the extreme. No doubt vast numbers of ova are lost every year at the head waters of salmon rivers by being frozen. Certainly in 1881 this loss was very severe on many Scottish rivers. The famous physiologist, Dr. Davy, brother of Sir Humphrey Davy, imbedded salmon eggs in ice, and found that they survived; but his experiments provided conditions probably more gradual than the severe and trying circumstances of freezing near the source of a river.

In order to keep the cans suitably cool an outside jacket of iron is often provided, separated by an empty space from the inside can containing the fry. Such double cans are very effective, and being much cooler than ordinary cans the fry are shipped in them with much greater safety and success. Whitefish fry which are very small and delicate will to the number of 15,000 to 25,000, travel in one of these cans without loss if the journey be not long and trying; but half that quantity of brook trout and salmon would as a rule suffice. Some authorities favour the wise principle of putting a minimum quantity of fry in each can and regard 3,000 to 5,000 as ample, but with newly hatched fry before the gills are properly developed,

* While galvanized iron is the best material, it must be remembered that the spirits of salt, used in soldering is very hurtful, and new cans, should stand full of water (often renewed) for eight or nine weeks.

and before they have acquired their full larval activity and vigour a greater number can be safely shipped in each can. Ten cans is a full shipment for one team, and fewer cans are in most cases advisable. At the famous Howietoun fish-ponds in Scotland, the lamented Sir James Gibson Maitland, whose recent death all interested in fish-culture must deplore, used a conical form of can 24 inches in diameter across the bottom, and 4½ inches in diameter at the top. The height of this can is 32 inches and the weight, when filled, about 170 pounds, so that two men could easily lift it about by means of two strong handles fixed at points a little above the centre of gravity (about 14 inches from the bottom). When it is necessary to convey the cans along forest paths or across rocky hills, two poles are horizontally attached to the handles, and the can is then easily carried—one man walking in front and the other behind. Many Scottish lakes situated on the highest altitudes have been successfully stocked by this method.

All fry should be planted immediately after arrival. If the hour of arrival at the planting ground be midnight or during the small hours of the morning so much the better, the atmosphere is then cool. In any case no time should be lost as every moment is of importance, and the sooner the fry are disporting themselves in the clear waters of the stream or creek the greater is the assurance of success. Under no plea whatever should fry be kept in the cans over the night. Great risk is run by a few hours' delay. If through the impossibility of obtaining a team or other cause it is absolutely impracticable to at once plant them they should be constantly watched and fresh water splashed in, or the water aerated by a bellows or other means. Aeration is most easily and effectively done by lifting up water in a dipper from the can and letting it fall again with a splash: but on no account should the device be adopted by blowing down a tube into the can with a view to aerating the water. Such an absurd plan has been actually adopted by some manipulators: but in blowing down poisonous air from the lungs, the water in the can already vitiated with carbonic acid gas, becomes more vitiated and poisonous. The surest way of killing and asphyxiating fish suffering from lack of oxygen is to blow air from the mouth into their midst.

Again, fry should not be unduly knocked about or the cans roughly handled. "Fry will not stand much knocking about," wrote the late Sir Gibson Maitland .....the bottom of a tank (or can) used for transporting fry should be stiffened by cross pieces soldered underneath, as, if it saggs at all, the fry soon get fatigued, possibly because the least spring from the bottom frightens them and they exhaust their strength by frequent and aimless sallies through the water." The same author also wrote, "With care fry can be carried for twenty-four hours: but the result is not satisfactory if the journey be longer.

Of course small quantities of fry can be sent further and more easily than large. The re-aeration of the water is a difficulty. It cannot be done automatically, as is the case with yearlings, because the motion the water acquires tires out the fry. In fact, the object of filling the tank well in to the cone of zinc is to check the motion."

It usually suffices in a long journey to change the water at appropriate intervals. The fact is well known that little salmon and trout, only 2 or 3 weeks old, actively wave their pectoral fins to and fro and thus create a current of water which aids in oxygenation, and facilitates the breathing operations of the fish.

The actual planting of the fry is a most important matter, and a good deal of very inappropriate advice has been published upon this matter.

It is clear that fry should not be suddenly transferred from a warm can to a can of water that is several degrees higher in temperature than the lake or stream.

The temperature should be somewhat equalized by mingling the two waters before the fish are emptied out. The temperature of the water into which the fry are to be transferred should not be more then 6° higher or lower than the water in which they have been carried from the hatchery.

It is hardly necessary to say that if fry are being sent some distance to be planted, it is an advantage to have all arrangements for their reception made before hand, so that teams may be waiting the arrival of the cans and an immediate start be made. Before placing the cans on the team it is advisable to remove the ice from

the covers of the cans unless the outside atmosphere be very warm. Cans of fish should never stand in the hot rays of the sun: but a cover or sheet should be so placed as to shield them. Cans should also be thoroughly rinsed and cooled with water before fry are placed in them. Fish frequently become sick before leaving the hatchery because this rule has not been observed and the fry placed in cans which have been warmed by the sun or nearness to a stove.

It is a good principle to find out where the fish naturally spawn in the waters to be planted, or if no fish of the same species occur, to ascertain where the best natural conditions exist. Thus whitefish should always be planted on clean gravelly ground in fairly shallow water, or where reefs of honeycomb rock extend. Brook trout and salmon should be placed near the head of streams or as far up tributaries of large rivers as possible, avoiding, however, those which dry up in summer.

Lake trout do best if distributed over rocky shoals such as are selected by the parent fish. In such places as those specified there is abundance of shelter, and the small fish, as a rule, make at once for niches in the rocks, or the protection of pebbles and stones. As pike, pickerel and other predacious fish are in the spring occupied in spawning, there is less danger from these fish than is commonly supposed, especially as the first-named are then in weedy, marshy localities engaged in depositing their eggs. If sunfish, shiners, small suckers and pike appear to abound, it is best to select some other areas which are free from these destructive pests, or if that is not possible drive these fish away by disturbing the water, sweeping a net over the ground or some such method.

It is often the case that neither time or circumstances will admit of reaching the best and most appropriate localities, and the planting must be done where it is apparent the young fry would not have b[illegible]nder natural conditions found. After much experience with young fry, I am [illegible]nd to confess that planting fry upon what may not appear the most suitable grounds results in better success than might have been anticipated. The charge often made against officials of merely dumping in the fry at the most convenient rather than the most suitable places is less grave than might be imagined by the inexperienced. A man standing on shore with one foot, encased in a fisherman's boot, in the water, can pour the fry gently into a deep part near the edge, and the fry will immediately seek shelter. A better plan is to gently empty the fry from a boat and the fry disperse before they reach the bottom. For a few minutes the mass of young fish appear to crowd together and then spread themselves and disappear from sight. That they survive and do well admits of no doubt as the remark, already made, applies in this case, viz., that the chief enemies of the young fish are in swampy shallows engaged in depositing their spawn. In thus favouring the planting of fry in deep water where it is a matter of difficulty to plant them in small batches in shallow water, I have the support of the late Sir Gibson Maitland who wrote: "At first we used to place the fry in the shallowest water near the inlet of the ponds; but they were so frightened that they used to be huddled together in masses..... .....when poured into deep water they instantly disperse, and in a few minutes have spread all over the pond in a lively and inquisitive spirit."

III.

THE PROPAGATION OF BLACK BASS

By Professor E. E. Prince, Dominion Commissioner of Fisheries, Ottawa.

That there are numberless sheets of water in various parts of the Dominion, which are suitable for black bass, but at present inhabited only by inferior fish or destitute of fish life altogether, admits of no doubt. The combination, in both species of black bass (the small mouth and the large mouth species), of the qualities of a fine game fish and an excellent food fish, renders them especially valuable, and their artificial culture and distribution, is a matter of importance. Their dauntless and hardy nature fits them for planting in new and untried waters, and unlike the timid and defenceless whitefish, they are bold and strong enough to hold their own against perch and pickerel (doré), or even the pike, and the more predacious kinds.

In the Government hatcheries, carried on under this department, black bass have not been hatched, nor are they suitable for the usual methods of artificial incubation in trays or in glass jars. In last year's Departmental Report (Appendix No. 1), in a somewhat exhaustive though condensed account of fishes' eggs, I referred to the ova of the black bass as not very favourable for artificial culture as they belong to that class of eggs provided with a soft mucilaginous coat, by means of which they are held together in tenacious masses. I referred to the fact (p. 24 of the same article) that they "are generally placed in a nest of more or less perfect construction. They become attached by this viscid envelope of jelly to pebbles, twigs and weeds, of which a kind of nest is usually constructed by the parent fish."

Eggs of this type, as I pointed out in the account referred to, are most unsatisfactory for treatment by the methods of artificial incubation. Only a small proportion of such eggs can be reared by the exercise of considerable care and trouble, and the results are altogether inferior to those secured when non-adhesive individually separate eggs, like those of the trout or whitefish are selected. The reason of this serious failure is complex and arises from several causes, such as the difficulty of obtaining ripe spawn, the peculiar nature of the eggs, which prevents perfect aeration, the evil of foul decaying matter, which finds lodgment in the egg-masses, and the contagion of adjacent dead eggs. Such eggs offer great facility for the germination of parasites and deadly fungi. The difficulties, referred to, were pointed out ten years ago by the late Professor J. A. Ryder, and in speaking of adhesive eggs, such as those of the black bass, he said "it is difficult to prevent the lodgment and rapidly fatal germination of the spores of *Saprolegnia* or *Achyla*, i.e., aquatic fungi or moulds, found in all fresh waters upon dead as well as living eggs. So rapidly do these fungi grow that in a very short time their ravages will extend over an entire tray of adhesive eggs. The eggs are destroyed by the fungus sending filaments into their substance, while the mesh of the mycelium also affords lodgment for dirt, so that the two together effectually shut off the possibility of oxygenating the ova, so that they are smothered."

In my earliest experience with the methods of fish culture, the fact was forcibly impressed upon me that the eggs which adhered in masses, like the eggs of the marine herring (*Clupea harengus*), the lumpfish (*Cyclopterus lumpus*), and other species, a considerable percentage failed to survive the necessary period of incubation, and as the dead eggs could not be torn out from the mass without injury to the attached healthy eggs, the adjacent eggs became fatally affected, and putrefaction spread through the whole mass.

By Professor Reighard's ingenious starch method the kinds represented by the adhesive pickerel's (or dore's) egg can be successfully handled and a larger percentage incubated than by any other method: but such eggs as those of the black bass are specially difficult to treat by any of these methods. The female bass even when in a ripe condition is able to retain her eggs by strong muscular effort, so that they do not flow freely when the hand of the fish culturist is gently pressed along the underside of the body. In many fishes it is impossible for the female to retain the eggs, when they are fully ripe, especially if pressure be applied: but in the case of the female black bass the case is entirely different. The male, too, presents a similar difficulty, and whereas a male salmon, or trout or whitefish, when ripe, is easily handled, and a supply of sperms or milt readily obtained, the male black bass is very obstinate in this respect.

Indeed some authorities state that the only reliable method is to secure the parent fish of both sexes, at the spawning time, and after killing them to remove the ripe eggs and milt from each. It is often found that specimens of male and female bass when obtained are not ripe at the same time, and disturbing them often prevents the process of spawning, so that the ripe reproductive elements are not discharged. No doubt great losses occur in some waters, especially in shallow creeks, which become partially or wholly dry in the months of June and July and later. These are precisely the months which are the most important in regard to the supply of black bass, for the eggs are then undergoing incubation and the fry are hatching out.

A plan was adopted some years ago by the State of Wisconsin for saving these imperilled ova and young fish, and in the report of the Fish Commissioners for the year 1893-4, they give the following details of the steps which they took:—

"The commissioners became satisfied in the summer of 1893 that great benefit would result to the state by the saving of the bass fry in the sloughs of the Mississippi River. That river overflows its banks in times of floods, forming shallow lakes and sloughs along the banks and on the islands. Into this shallow water the bass go to deposit their eggs. On the subsidence of the waters the parent fish return to the channel waters. The eggs hatch by the millions and the young fish are left to perish, either by the sloughs drying up in summer or freezing in winter. Mr. Nevin made careful examination, and after correspondence with Hon. Marshall McDonald, the United States commissioner, the work of rescuing these young fish, depositing the common varieties in the nearest channel waters and saving the bass and pike for distribution to other portions of the state, was begun in the month of September, 1893. The work was new to Mr. Nevin and his assistants when commenced, and experiments in methods were necessary. But it is believed that excellent results will follow this work. Superintendent Nevin, in his report, says: "I regard the rescuing and distribution of fish from these low places along the river, where they would otherwise inevitably perish, as one of the most economical and practical methods of re-stocking our inland lakes. All the fish so planted are adapted to any of the waters of the state; and the cost of taking and planting them is very small compared with the cost of the artificial propagation of the same species, since we now have a fish car for transporting the live fish." Hon. Marshall McDonald, the United States commissioner of fisheries, writes that "in no other way can so valuable results be accomplished from so small an expenditure."

The removal of adult black bass requires special care at the breeding time, as it may happen that the fish have already prepared their nests and placed their eggs therein, or even hatched their young. These young fry if left without parental protection, as a rule, fall a prey to predacious enemies. The Vermont commissioners, in their Fisheries Report for 1888, quote the experience of Mr. C. F. Holt with a batch of these forsaken black bass, who says: "When I went out in the morning the mother fish was gone. I thought I would secure the young fish (they were just hatched), and take them to the house and 'bring them up by hand.' So, putting on my wading boots. I walked out to the bed, and there I found, not the young fry, but three or four crayfish and some minnows, which had evidently devoured every fish on the bed. At another time, under similar circumstances, except that the eggs

were not hatched, the crayfish had destroyed all the eggs. I took up every pebble without finding a single one." Although the eggs appear to hatch in about a week or ten days, the transparent and delicate fry are guarded for many weeks. This period of protection lasts from one to two months.

The experiment has been tried of removing the eggs from the nest and artificially rearing the fry, but the difficulty of aeration, as already pointed out, is great, and many eggs are lost from fungus and non-aeration.

The only really feasible modes of black bass propagation by artificial means are the simple methods of (1) transferring adult parent fish, (2) half-grown fish, or (3) small fry after the period of parental protection is over.

Of the transportation and planting of full-grown fish, it is not necessary to say much. Success has attended the transplantation where it has been tried, and the well-known experiments of the Marquis of Exeter, Mr. Alexander Begg, of Victoria, B.C., of Mr. Max von dem Berne, of Berneuchen, and others, have shown that good results can be ensured by such attempts. In Mr. von dem Berne's experiments only three fish survived out of a considerable number, but they produced eggs which yielded, after the male had fertilized them, broods of young, no less than 1,300 in total number. The number of eggs yielded by a single female varies from 2,000 to 10,000.

I quote, from the narrative of Mr. Silk, the details of the Marquis of Exeter's shipment of black bass across the Atlantic:—

"All of the black bass that I brought in 1878 from the United States of America were taken from the Delaware River. I placed them in boxes floating in the stream ready to be taken away. On the day preceding the sailing of the steamer for England they were placed in the tanks I had prepared for them by the river side. We got them to the train without any loss, and on arriving in New York had them placed on the main deck of the steamer; it was then 11 p.m., we having left the Delaware River at 3 p.m. Up to this time I had no loss; my greatest trouble was the high temperature it stood at—78 deg. all night. I kept the water as cool as possible with ice. I stayed by the tanks all night pumping air every few minutes, and keeping people from meddling with them. When daylight came I examined the tanks and found five dead fish, which I removed at once. It was now 5 a.m., and the ship was to sail at 6 a.m. I got some men to assist me in changing the water in the tanks. I had one spare tank, which I filled first, then reduced the temperature from 75 deg. as it came out of the hydrant to 58 deg., then placed the bass in it, and so on until I had given them all fresh water. We sailed at 6 a.m sharp. When we got out to sea a few miles, I made arrangements with two of the steerage passengers to assist me on the voyage. It was then 9 a.m. I gave them both instructions what to do. After this I arranged with my men to keep watch two hours each, and to relieve each other at meal times. I always took four hours' watch in the night. I then roused one of the men and gave over the fish in good order. If there were any dead I always took them out at once. I made it a point never to go to my cabin at night. We got on very well the first day, as it was cooler, but after this we got into the Gulf Stream; both the air and sea were very hot, the atmosphere 85 deg., and the water in the sea 78 deg. It was during these five days we lost the most fish. We cleared the water every day by straining it through flannel, all thick and dirty water we threw away and added some fresh water made by melting ice. The sixth day out we got into cooler weather, and the fish commenced to do better. The temperature of the atmosphere dropped to 57 deg. We used very little ice unless to make fresh water with. We kept on like this until we reached Liverpool, after ten days' passage. I now got fresh water and changed all the tanks. The fish did not object in the least, but were quite lively. It did not hurt them changing the water from American to British. I got them conveyed to the railway station and placed on a truck. We arrived in Stamford in due course, and on counting the fish I found we had 153. I left the Delaware with 250, so that I had lost 97 fish in twelve days.

In 1879 I went again, and started from America with 1,200 black bass, and on arriving home I had 812, having done better than I did on the previous occasion.

All of the black bass were for the Marquis of Exeter, he having borne all the expense of the experiment. Most of the fish were placed in a lake belonging to his lordship called Whitewater, near Stamford. Not any of them have been caught yet. From what I could learn they would be about half-a-pound each in weight, so that they had done very well. The first lot that were put in will be three years old in April, when they are expected to commence breeding."

For merely shipping from one lake or river to another where the distance is comparatively short it is not necessary to adopt more than the usual precautions observed in shipping any other live fish. It is very advisable that as few as possible adult fish be placed in one tank or barrel, as bass are provided with sharp spines, and are apt to seriously wound each other if too closely confined. Twice as much room should be allowed for bass as for species whose fins are soft-rayed. To transplant bass all that is necessary is to procure the adult parent fish from fishermen or otherwise and transport them alive to the waters to be stocked.

This plan can be readily carried out by arranging with fishermen who are in the habit of netting these fish, telling them to be careful in taking them from their nets without injuring them and placing them in cribs sunk in the water near by until found convenient to transport them to their intended destination; this can be done quite safely if the distance is not too great by putting say 10 or more bass in the ordinary sized water barrels, say 30 or 40 gallons three parts filled with water. If they are to be carried short distances, spring wagons or sleighs may be used, for longer distances shipment by railway.

Numbers of bass have been transported in this way from Belleville on the Bay of Quinté up to the Newcastle Government hatchery, where all of them except those which had been severely injured by the nets arrived safely and large numbers of fry were hatched and reared in the natural way in their circumscribed inclosures or ponds.

With ordinary care and attention given to the netting, cribbing, transporting, and planting of black bass in new waters success is ensured. Little need be said of the transporting and planting of black bass fry. They should be collected soon after the period of parental guardianship and may be netted in schools by means of a fine meshed dip-net, or a seine. Black bass 2 to 4 inches long are very suitable for the purpose, and they attain that size in the fall of their first year. Black bass 5 to 6 inches long are about a year old, but when first hatched they are barely $\frac{3}{4}$ in. in length. In a 15 gallon cask 1000 yearling bass have been shipped a distance of 500 or 600 miles: but the fewer that are placed in each can or cask the more likely is success to be secured. In the late autumn bass can be carried most safely, but many successful cases of transplantation have occurred which took place in July and August. The Department of Marine and Fisheries in 1896 sent a small consignment of black bass to British Columbia from Western Ontario, and a proportion of them arrived on the Pacific coast in good condition, as stated in last year's report. Through an accident and detention in the Rocky Mountains, many of the fish, however, died on the way. Small black bass are very cannibalistic, and those of fairly uniform size only should be placed in the same pond.

On the whole the transference of adult fish is the most practical and successful plan, and 40 or 50 such fish placed in a pond of moderate dimensions will in the course of a few months in summer rear many thousands, 50,000 to 100,000, young fry and thoroughly establish themselves.

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